Original Specification

YARN FEED SYSTEM AND CABLE FOR SAME

[0001] The invention relates to a yarn feed system with electrical components and to a cable for making contact with such a yarn feed system.

[0002] Yarn feed systems are used for instance in knitting machines or other textile machines for feeding a yarn to a yarn-consuming station, for instance at a predetermined tension or in a prescribed quantity. The yarn feed systems draw the yarn from a bobbin and keep it in readiness on a drum for consumption by the yarn-consuming machine, or feed it to that machine. Such yarn feed systems are usually secured in relatively large numbers on a suitable mount, such as a so-called machine ring. For that purpose, they have a clamp. Besides the mechanical connection with the textile machine, such yarn feed systems as a rule also require an electrical connection, so that existing electrical components can be connected.

[0003] From German Patent Disclosure DE-OS 21 48 653, a yarn feed system in the form of a yarn storage feeder is known, which has a yarn feed drum that is driven under the control of an electric motor. The drum and the motor are secured to a horizontally extending mount, which on its free end has a jawlike clamp that is open at the bottom. A hooklike leg of this clamp has a clamping screw, whose axis is oriented transversely to the opening direction of the jaw. On the side facing the clamping screw, there are a plurality of contact pins, which have sharpened tips. They serve to pierce the insulation of a cable and make contact with the conductors present in the cable. The cable is a ribbon cable, which is disposed on a carrier (machine ring) of rectangular cross section. The contacts, in at least one version, are supported axially movably, so that upon meeting the cable they can still be thrust backward somewhat.

[0004] In making contact, it is important that the contact pins securely meet the conductors that are concealed within the cable. The connection of a yarn feed system to a textile machine must therefore be made with care. The degree of care employed with the yarn feed system, however, cannot be determined in advance by the manufacturer of the yarn feed system.

[0005] With this as the point of departure, it is the object of the invention to create a yarn feed system which can be connected mechanically and electrically correctly to a textile machine in an especially simple, secure way.

[0006] It is furthermore the object of the invention to create a cable which in a way that is relatively invulnerable to error reinforces a secure connection of the yarn feed system to a textile machine.

[0007] This object is attained by a yarn feed system of claim 1 and additionally or alternatively by a cable of claim 14:

[0008] The yarn feed system of the invention has a fastening clamp with contact pins. The contact pins are preferably disposed in stationary fashion. However, in individual cases, it can be expedient for the contact pins to be axially movable instead.

[0009] The individual contact pin or contact pins (if there are more than one) are assigned a guide element, which guides the cable, particularly relative to the transverse direction of the conductor, in the insulation-piercing operation of the contact pins. The guide element is preferably adapted to the contour of the conductor. The conductor is formed for instance by a flat multi-cord cable of rectangular cross section. Accordingly, the guide element then has a jaw of approximately rectangular or even trapezoidal cross section, which maximally corresponds to that of the flat multi-cord cable. The guide element is supported movably only longitudinal, but not transversely to the contact pins, and as a result in the insulation-piercing operation it holds the cable so firmly that the contact pins securely meet the conductor or conductors of the cable.

[0010] In the first embodiment, the guide element is supported in stationary fashion relative to the main body, and the contact pins are supported axially movably. In the position of repose, the contact pins are retracted far enough that they do not protrude into the interior of the guide element. Thus the cable can be introduced into the guide element by placing the yarn feed system on the machine ring. As the fastening screw is screwed in, first the yarn feed system is fixed as a result. As the fastening screw continues to be screwed farther in, it can be accomplished by a deflection mechanism that the contact pins are thrust forward axially and thus pierce the cable. Alternatively, however, it is also possible for the contact pins to be activated by a separate actuating means, such as a lever, for instance via a cam drive or a separate screw; that is, the

contact pins can be made to pierce into the interior, enclosed in jawlike fashion by the guide element, so as to make electrical contact with the cable.

[0011] Alternatively, the contact pins can be stationary and instead the guide element can be disposed movably. This is particularly applicable to especially simple, robust embodiments. Then the guide element is supported preferably resiliently, and a spring means serves to tense the guide element into a receiving position. In the receiving position, it is located in front of the tips of the contact pins. As a result, it assures that the cable or some other conductor can be introduced into the guide element without becoming caught on the tips of the contact pins and thereby forced out of its desired position. Even if the cable is retained only relatively loosely on the machine ring (support rail) of the textile machine, for instance by means of cable binders, this makes correct contacting of the conductors of the cable possible, even if the yarn feed systems are installed somewhat carelessly.

[0012] The contact pins can be connected to various electrical components of the yarn feed system, such as an electrical switch, a sensor, a display device, a motor, a magnet coupling, or the like. The line that belongs to the textile machine and is contacted by the contact pins preferably leads to a central controller of the machine. Individual lines can be connected to a power supply. The lines can be signal lines and/or supply lines.

[0013] The contact pins are preferably embodied as insulation- piercing contacts in the manner of needles. They can have a round or angular (flat) cross section, for instance so that they can drill through a conductor. This is especially practical if the conductor is embodied as a flexible lead. It is also possible for the insulation-piercing contacts to be embodied as insulation displacement contacts, for instance in the form of longitudinally slit contact tongues. These tongues pierce a cable insulation and receive the conductor in their slit, thereby contacting it.

[0014] As the cable, a ribbon cable with one, two or more conductors can be used. The ribbon cable has a preferably rectangular cross section (with rounded corners). In this case, the guide element assures that the contact pins will meet the conductors in the insulation-piercing operation. In a preferred embodiment of the cable, the cable has recesses, on at least one side toward the insulation-piercing contacts, which guide the insulation-piercing contacts and the cable relative to one another in the insulation-

piercing operation. The recesses are for instance grooves disposed parallel to the conductors; the grooves may be embodied in one flat side of the cable or in both opposed flat sides. With respect to a plane oriented radially to the conductor and perpendicular to the flat side, the grooves are preferably disposed centrally to that plane. The grooves may be assigned to some of the conductors or to all of the conductors. In a preferred embodiment of the cable, the cable has two thicker conductors, embodied as flexible leads, which for instance act as supply lines, along with one or more thinner flexible conductors, which serve for instance as a signal line. In that case, the flat sides of the cable are provided with grooves only in the region of the signal lines, and the outer contour of the cable otherwise hardly deviates from a rectangle.

[0015] Further details of advantageous embodiments of the invention will become apparent from dependent claims, the drawing, and/or the description.

[0016] In the drawing, exemplary embodiments of the invention are illustrated. Shown are:

[0017] Fig. 1, a yarn feed system with a belt drive, in a schematic side view;

[0018] Fig. 2, a yarn feed system with a motor drive, in a schematic side view;

[0019] Fig. 3, a clamp of the yarn feed system of Fig. 1 or Fig. 2 for mechanical fastening and electrical contacting of the yarn feed system, in a schematic side view on a different scale;

[0020] Fig. 4, the clamp of Fig. 3 on being fitted over a support rail or machine ring, in a side view partly in section;

[0021] Fig. 5, the clamp of Fig. 4 upon fastening to the machine ring;

[0022] Fig. 6, the clamp in the firmly tightened state, in a side view partly in section;

[0023] Fig. 7, an embodiment of a cable for contacting yarn feed systems, on a larger scale and in a sectional view; and

[0024] Fig. 8, a modified embodiment of a yarn feed system with movably supported contact pins, in a side view partly cut away.

[0025] In Fig. 1, a yarn feed system 1 is shown which a main body 2 in the form of a mount or housing that is to be secured by a clamp 3 to a support rail or machine ring 4 of a textile machine, such as a knitting machine. The main body 2 projects in self-supporting fashion and supports a yarn feeder 5. In the embodiment of Fig. 1, the yarn feeder is formed by a yarn feed wheel 6, which is disposed below the main body 2 and is supported by a rotatably supported shaft 7 that vertically penetrates the main body 2. This shaft, on its upper end above the main body 2, carries one or more pulleys 8, 9, which can be selectively coupled to the shaft 7 via a coupling disk 11. A yarn brake 12 which is disposed on the free end of the main body 2, located away from the clamp 3, as well as one or more yarn feeler levers 13, 14 can be associated with the yarn feed wheel 6 and are disposed for instance in front of and behind the yarn feed wheel 6 in the yarn travel path and are supported pivotably on the main body 2. These levers are connected to switches 13a, 14a, disposed in the interior of the main body 2, which open or close an electrical current circuit when the applicable yarn feeler lever 13 or 14, under the influence of its own weight and/or a reinforcing spring, pivots out of a raised position into a position in which it hangs freely downward. To indicate this state, a signal lamp 16, which is switched on and off by the yarn feeler lever 13 and/or the yarn feeler lever 14, is disposed on an extension 15, preferably extending vertically downward, of the otherwise essentially horizontally disposed main body 2.

[0026] For supplying power to the signal lamp 16 and/or for signalling the state of the yarn feeler lever 13 and/or the yarn feeler lever 14, a flat multi-cord cable 17 is disposed on the machine ring 4. This cable is fixed to some extent to the machine ring 4 by cable binders, adhesive tabs, or the like.

[0027] The clamp 3 is formed by a jaw that is open at the bottom. The jaw includes a leg 18 which initially extends horizontally in a rectilinear prolongation of the main body 2 and then, bent at a right angle, extends vertically downward. The leg 18 defines a jaw 19 whose vertical height is approximately the same as the height of the machine ring 4, and whose horizontal width is greater than the width of the flat multi-cord cable 17 and of the machine ring 4 together. In side view, the jaw 19 has an approximately rectangular contour. For firmly clamping the yarn feed system 1 to the machine ring 4, a clamping screw 21 is used, which is seated in a horizontally oriented threaded bore of the leg 18. The threaded bore and the clamping screw 21 are disposed approximately centrally in the jaw 19.

[0028] The flat multi-cord cable 17 is disposed on the side of the machine ring 4 remote from the clamping screw 21. Contact pins 22, 23, 24, 25 that can be seen in Figs. 3 and 4 are disposed on this side of the jaw 19 and are retained parallel to and spaced apart from one another and insulated electrically from one another on the main body 2. They extend toward the leg 18 and are aligned essentially parallel with the clamping screw 21. The contact pins 22 through 25 are preferably retained in stationary fashion and are disposed vertically one above the other. However, they can also be offset from one another in terms of the longitudinal direction of the flat multi-cord cable 17, that is, perpendicular to the plane of the drawing in Fig. 4, so that the punched holes that are to be formed in the flat multi- cord cable 17 will be spaced farther apart from one another. Each contact pin 22 through 25 preferably has a length such it does not touch the flat multi-cord cable 17 when the flat multi-cord cable is introduced with the machine ring 4 into the open jaw 19. On their respective free ends 26, 27, 28, 29, the contact pins 22 through 25 are provided with a tip, which is suited for piercing the insulating sheath 31 of the flat multi-cord cable 17. A plurality of conductors 32, 33, 34, 35 are disposed in this sheath 31, preferably being formed by a flexible copper lead. The vertical spacings of the conductors 32 through 35 match the vertical spacings of the contact pins 22 through 25.

[0029] The tips 26 through 29 of the contact pins 22 through 25 protrude into a jawlike recess 36, whose size is slightly in excess of the cross section of the flat multi-cord cable 17. However, the tips 26 through 29 do not protrude out of this recess 36. In the region of the contact pins 22 through 25, a chamber on the order of a vertical slit is formed in the applicable wall in which the recess 36 is embodied, and a guide element 37 is seated in this chamber or slit. This guide element 37, preferably made from plastic, has a jaw 41 defined at the top and bottom by two protrusions 38, 39; this jaw corresponds in size to the cross section of the flat multi-cord cable 17 and opens toward the clamping screw 21. Between the protrusions 38, 39, the guide element 37 has an essentially plane seating face 42, which is penetrated by bores 43, 44, 45, 46. The bores receive the contact pins 22 through 25, as can be seen particularly from Fig. 1.

[0030] In Figs. 3, 4 and 5, the guide element 37 is shown in its receiving position. It is supported movably longitudinally of the contact pins 22 through 25 and to that end is retained on an integrally molded spring arm 47. This spring arm can also be seen in

Fig. 1. As a result, the guide element 37 is movable to the extent that it can be pressed into the slitlike recess in which the contact pins 22 through 25 are seated. Its back 48 can as a result be made to approach the bottom 49 of the applicable recess.

[0031] The yarn feed system 1 described thus far is installed on a machine ring 4 as follows:

[0032] For installation, the clamping screw 21 is first screwed out of the jaw 19 far enough that the jaw 19 is completely free. In this state, the yarn feed system 1 is placed with its clamp 3 onto the machine ring 4 from above. The flat multi-cord cable 17 is then located opposite the jaw 41 of the guide element 37. This situation can be seen in both Fig. 1 and Fig. 4. If the fastening screw 21 is now tightened somewhat, then as Fig. 5 shows, the flat multi-cord cable 17 moves into the jaw 41 of the guide element 37. The guide element 37, guided precisely in the vertical direction by its spring arm 47, receives the flat multi-cord cable 17 between the protrusions 38 and 39 and corrects its height, if necessary, so that its conductors 32 through 35 are located precisely at the height of the contact pins 22, 23, 24, 25.

[0033] If the fastening screw 21 is now tightened still more, then the flat multi-cord cable 17 and the guide element 37, as Fig. 6 shows, are thrust onto the contact pins 22 through 25. While the guide element 37 disappears in the recess surrounding the contact pins 22 through 25, the flat multi- cord cable 17 moves into the recess 36, which is defined at the top and bottom by steplike stops 51, 52. The contact pins 22 through 25 penetrate the sheath 31 of the flat multi- cord cable 17 and pierce the conductors 32 through 35. This situation is shown in Fig. 6. In the process, the machine ring 4 is tensed against the stops 51 through 52, whose seating faces are located in the same plane, and as a result the mechanical fastening of the yarn feed system 1 is attained as well.

[0034] Fig. 2 shows a modified embodiment of the yarn feed system, in which the drive of the yarn feeder 5 is effected by means of a motor 53. The motor is seated on the main body 2 at the top and replaces the pulleys 8, 9 of Fig. 1. The motor 53 is controlled for instance by yarn tension sensors, not further shown, on the yarn feed system 1. For supplying energy to the motor 53, the flat multi-cord cable 17 on the machine ring 4 is again used. Its contacting is effected as described above. The clamp 3 and the electrical contacting device formed by it are embodied as shown in Figs. 3

through 6. These figures and their description as well as the description of Fig. 1 are referred to accordingly.

[0035] In Fig. 7, a modified embodiment of the flat multi-cord cable 17 as a flat multi-cord cable 54 is shown. The flat multi-cord cable 54 has an insulating sheath 31, whose cross section has an approximately rectangular outline. A plurality of cores, for instance six cores, 55, 56, 57, 58, 59, 60 are accommodated in the sheath 31 and are embodied for instance as flexible copper leads. Each of the cores 55 through 60 is surrounded by its own insulation 61, 62, 63, 64, 65, 66. The insulations 61 through 66 can be in different colors. All the cores 55 through 60 are disposed in the same vertical plane 67, which is oriented parallel to the flat sides 68, 69 of the flat multi-cord cable 54. While the cores 55, 56 for instance serve as energy supply lines and have a larger cross section, the cores 57 through 60 can serve as signal lines and have a correspondingly smaller cross section. Accordingly, the center-to-center spacings of the cores 57 through 60 are also less than the center-to- center spacings of the cores 55, 56. The center-to-center spacings of the cores 57 through 60 may be less than half the thickness of the flat multi-cord cable 54, or in other words less than the spacing of the vertical plane 67 from one of the flat sides 69 and 68. The secure, correct contacting of the cores 57 through 60 is facilitated, under these circumstances, by grooves 71, 72, 73, 74, 75, and grooves 76, 77, 78 embodied in the flat sides 68 and 69, respectively. At least one of the two flat sides 68, 69 is provided with corresponding grooves. The groove 71 is disposed approximately centrally to a radial plane 79 of the core 57, which is perpendicular to the vertical plane 67. Accordingly, the groove 71 is located at the same height as the core 57. In the same way, the grooves 72, 73, 74 are at the same height as the cores 58, 59, 60, respectively. The grooves 75 through 78 likewise are located at the same height as the respective cores 57 through 60.

[0036] A flat multi-cord cable 54 of this kind is especially well suited for piercing, both with and without a guide element 37. The grooves 71 through 74 guide contact pins that perform the piercing. Conversely, if the contact pins come to rest like the teeth of a comb in the grooves 71 through 74, then the flat multi-cord cable 54 is automatically oriented positionally correctly in its height with respect to the contact pins.

[0037] Fig. 8 illustrates a further embodiment of a yarn feed system 1. To the extent that it agrees with the yarn feed systems described above, reference is made to

the above description and the same reference numerals. The differences from the above description are as follows:

[0038] In the yarn feed system of Fig. 8, the guide element 37 is formed by a corresponding contour 81 in the side wall, toward the flat multi-cord cable 17, of the jaw 19. The contact pins 22, 23, 24, 25 are outside the contour 81, in the position of repose. They are carried by a carrier 82, on which they are supported in stationary fashion, parallel to and spaced apart from one another, and retained in insulated fashion. Via flexible conduction means (a flexible printed circuit board or the like), the contact pins 22, 23, 24, 25 are connected to a further electrical circuit, not shown, or to the motor 53, the signal lamp 16, and/or some other electrical device. The carrier 82 is supported axially movably relative to the contact pins 22, 23, 24, 25 by a guide device 83. The guide device 83 is symbolized in Fig. 8 by two sliding guides, which are disposed on the two ends of the carrier 82. Alternatively, resilient ribs or similar means could be used here, by way of which the carrier 82 can be joined to the main body 2. For actuation, that is, for purposefully causing the contact pins 22, 23, 24, 25 to pierce the flat multi-cord cable 17, a separate drive mechanism is used, which in the present exemplary embodiment is formed by a rotatably supported eccentric element 84. The eccentric element 84 is formed by a cam 85, which is connected in a manner fixed against relative rotation to a hand lever or similar actuating device, not otherwise shown. It serves to displace the carrier 82 axially. A spring means, not shown, prestresses the carrier 82 into its retraction position, shown in Fig. 8, in which the contact pins 22, 23, 24, 25 do not enter into the jaw 41. However, if the cam 85 is pivoted somewhat, this causes an axial displacement of the carrier 32, as a result of which the contact pins 22, 23, 24, 25 do move into the jaw 41.

[0039] The yarn feed system 1 of Fig. 8 is used as follows:

[0040] If it is to be installed on the machine ring 4, then it is placed thereon, as Fig. 8 shows. The carrier 82 is then in the retraction position shown, so that the jaw 41 is now free. Now the fastening screw 42 is tightened, as a result of which the yarn feed system 1 is firmly clamped to the machine ring 4. The flat multi-cord cable 17 rests in the jaw 41 then and is not yet contacted. By a rotation of the cam 85, the contact pins 22, 23, 24, 25 are displaced axially, so that they penetrate the flat multi-cord cable 17 and contact its conductors 32, 33, 34, 35. Either by its shaping or by means of a separate detent or locking device, the cam 85 remains in this position. However, it is

also possible to dispense with such locking and to rely on the fact that the contact pins 22, 23, 24, 25 that have been made to pierce the flat multi-cord cable 17 will remain in place by frictional engagement.

[0041] In the embodiment of Fig. 8, an actuating device is provided that moves the carrier 82 toward the flat multi-cord cable 17; retraction is either not intended, or is effected by a spring means. Alternatively, it is possible to provide an actuating device that acts in both pushing and pulling fashion, such as a toggle lever drive, threaded drive, sliding block, or the like.

[0042] The yarn feed system 1 of the invention has a clamp 3 for fastening on a machine ring 4. Contact pins are disposed on the clamp 3 and serve the purpose of piercing the insulation of a flat multi-cord cable 17 retained on the machine ring 4. For positionally correct orientation of the flat multi-cord cable 17 before and during the insulation- piercing operation, a guide element 37 is used, which is supported movably on or at the clamp. In the vertical direction, it is preferably retained by a spring arm 49. On its flanks, the flat multi-cord cable 17 preferably has grooves, which can likewise serve to orient the flat multi- cord cable positionally correctly before and during the insulation-piercing operation. The tips of the contact pins are located in the grooves and thereby bring about the alignment of the flat multi-cord cable 17 or 54.

[0043] List of Reference Numerals:

1	Yarn feed system
2	Main body
3	Clamp
4	Machine ring
5	Yarn feeder
6	Yarn feed wheel
7	Shaft
8, 9	Pulley
11	Coupling
12	Yarn brake
13, 14	Yarn feeler lever
15	Extension
16	Signal lamp
17	Flat multi-cord cable
18	Leg
19	Jaw

21	Clamping screw
22, 23, 24, 25	Contact pins
26, 27, 28, 29	Tip
31	Sheath
32, 33, 34, 35	Conductors
36	Recess
37	Guide element
38, 39	Protrusions
41	Jaw
42	Seating face
43, 44, 45, 46	Bores
47	Spring arm
48	Back
49	Bottom
51, 52	Stops
53	Motor
54	Flat multi-cord cable
55, 56, 57, 58, 59, 60	Cores
61, 62, 63, 64, 65, 66	Insulation
67	Vertical plane
68, 69	Flat side
71, 72, 73, 74	Grooves
75, 76, 77, 78	Grooves
79	Radial plane
81	Contour
82	Carrier
83	Guide device
84	Eccentric element
85	Cam